UNIVERSITY of TASMANIA | IMAS
INSTITUTE FOR MARINE & ANTARCTIC STUDIES

2022 SMALL BIVALVE FISHERY ASSESSMENT
Venerupis largillierti - Northern Zone, Georges Bay

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Executive Summary

In 2022, a single stock assessment with total allowable commercial catch recommendations (TACC) was conducted for the Georges Bay Northern Zone Venus Clam, *Venerupis largillierti,* fishery.

Venus Clam, *Venerupis largillierti* - Georges Bay Northern Zone

A stock assessment on the introduced Venus Clam was conducted in the Georges Bay Northern Zone in June 2022 and covered 82,946 m^2 of historic Clam beds. Estimated total biomass was 10.0 tonnes with lower and upper 95% confidence limits of 4.4 t and 15.6 t. An estimated 83% (8.4 t) of the biomass was above the legal size limit of 40 mm. The total biomass is 14% of that estimated in 2017 (76 t) and 2% of that estimated in 2012 (537 t). The decline in biomass can be attributed to ecological change in the estuary; recent harvest volumes in this fishery have been low. Observed changes include a doubling of native oyster (*O. angasi*) biomass between 2016 (4.7kg/m^2; Jones and Gardner, 2016) and 2021 (10.0 m^2; Keane, 2021), as well as increase in seagrass densities, over key Venus Clam beds. If high abundances of native oyster and seagrass persist in the estuary, there will be continued negative pressure on Venus Clam stocks.

A TACC based on 10% of the exploitable biomass would be 0.84 t. However, the estimated total biomass of 10 t is well below the Biomass Limit Reference Point (B_{LIM}) of 107.5 t recommended by IMAS (Jones and Gardner, 2016). Reference points in this fishery are based on a B_0 of 537.4t, the maximum estimated biomass recorded in the fishery since its inception (2012). Adequate management measures are in place for the fishery but are not resulting in measurable improvements due to environmental influences. Based on this the Stock Status is classed as Depleted.

Recommended stock management options include a) fishery closure, based on biomass estimate and harvest strategy implementation, and b) significantly reduced TAC with fishery monitoring provisions (e.g. GPS logging and size structure sampling) to enable data flow through the stock recovery phase. Additional management recommendations include a) review of management objectives of this species, noting that this is an introduced species, b) review the appropriateness of stock/fishery assessment methods and fishery reference points, given environmental change in the estuary, stock levels and fishery value, c) implementation of mandatory use of GPS and depth/time logger to spatially define the fishery area, to facilitate the use of accurate fishery data in assessments, and to categorise the spatial overlap with other fisheries.

Stock status – small bivalves

The commercial small bivalve fisheries in Georges Bay and Ansons Bay are surveyed every two to three years for the purposes of estimating total biomass and assessing fishery status in order to assist with the allocation of quota for the forthcoming fishing years.

The status of Tasmania's small bivalve's fisheries have been assessed in terms of the lower acceptable limit of the stock, which is the point where recruitment overfishing occurs. Recruitment overfishing implies that the mature adult (spawning biomass) is depleted to a level where the future productivity of the stock is diminished. Recruitment overfished stocks have not necessarily collapsed, but do have fewer recruits than a healthy stock.

It's important to note that fishery management generally includes both limit reference points that define the lower acceptable point for the stock plus target reference points, which are the ideal level for the stock. In this report the fishery is assessed against only the limit reference point.

Stock status of the bivalve fishery was based on density and size composition data from the most recent surveys, plus consideration of trends in catch and CPUE data.

Species	Status	Comments
Northern Zone Georges Bay - Venus Clam ***Venerupis largillierti***	DEPLETED	Biomass in the Venus Clam fishery is estimated at 10.0 t based on quadrat counts that are extrapolated across the defined beds. The stock extends beyond the boundaries of the beds so the fishery biomass is less than the total biomass of clams in Georges Bay. The current low biomass combined with declines in CPUE since 2015 provides evidence that the stock is at an historical low level. Fishing has been low with less than 5% of the estimated biomass taken as catch since 2017. Less than 14% of the TACC has been harvested since 2020. This is evidence that the stock has not been reduced by excess fishing mortality. Rather, increases in Native Oyster biomass and Seagrass appear to be putting significant negative pressure on Clam stocks. Adequate management measures are in place for the fishery but are not resulting in measurable improvements due to environmental influences. Based on this the Stock Status is classed as Depleted

Venus Clam - Northern Zone Georges Bay

Background

A commercial dive fishery has operated for the Venus Clam, (commonly known as Venerupis; (*Venerupis largillierti*) in Georges Bay, north-east Tasmania since approximately 1985. The Venus Clam is endemic to New Zealand but was found in Tasmania in 1963. It remains indistinguishable from New Zealand populations, on the basis of allozyme analysis (Macguire, 2005). Venus Clams grow to a length of 70 mm and are found in the intertidal zone and subtidally in both muddy and sandy substrates in shallow estuarine waters on parts of Tasmania's east and south-east coasts (Grove, 2011). Experimental estimation of growth rates indicate growth increments at 1.3 mm.month^{-1} at 27 mm and 0.5 mm.month^{-1} at 43.5 mm (Kent et al., 2005; Maguire, 2005). Sexual maturity is estimated to occur below 27 mm (Maguire, 2005). Georges Bay is the only commercial fishery for this species in Tasmania, where the species forms beds on both intertidal sandbars and in subtidal deeper channels subjected to tidal flow. The Georges Bay Venus Clam Fishery is subdivided into two zones (Northern and Southern) with two licences issued in the Northern Zone and one in the Southern Zone (DPIPWE, 2007). Fishing has ceased in the southern zone due to stock decline and an increase in seagrass abundance, and the licence has lapsed.

The Northern Zone fishery operates on mixed species shellfish beds in the bay with the area harvested varying between years. Until 2007 the fishery was managed principally through the allocation of half yearly or yearly permits. From 2007 a formal TACC structure was introduced with two associated commercial licences (DPIPWE 2007). TACC allocation is based on fishery dependent surveys of estimated available biomass conducted every two or three years with the TACC set as equal to 10% of the estimated biomass. Legal minimum length of *V. largillierti* is set at 40 mm shell length on the basis of market demand (DPIPWE 2007). Total catch and catch per unit effort data are available for this fishery from 1st September 2007 onwards, with the fishing year operating from 1st September to 31st August.

For the 2015-2016 fishing year, the two licensees implemented a voluntary reduction in TACC to 3 t as a consequence of low observed biomass. Due to low biomass and catch, an independent biomass survey was not requested by DPIPWE for 2016. The stock assessment conducted in 2017 was the first full survey since the stock decline, and showed that the biomass in 2017 was 16% of that estimated three years prior (Keane and Gardner, 2017). Planned assessments for 2020, and then 2021, were postponed due to a combination of very low harvest and Covid restrictions.

The objective of this survey was to estimate the biomass of Venus Clams within the Georges Bay, Northern Zone to update TACC setting information for the 2022/23 season and beyond.

2022 assessment

This survey used a systematic random sampling design that covered known historical commercially fished beds. The survey primarily focused on two beds that were mapped in 2017 and formed the assessment area for that year. The survey was extended to include additional beds first mapped in 2008, an area identified by one of the licence holders, as well as some adjacent areas to beds to determine if high densities of clams were present outside of the defined boundaries. For the assessment the three beds were included; the two surveyed in 2017 assessment and a third small bed to the East (Figure 1).

Figure 1. Georges Bay, showing the position of the three clam beds assessed in 2022 (Bed 1 - 2017, Green 37,152 m^2; Bed 2- 2017, Blue 43,607 m^2 and Bed 3 - New, Purple, 2,187 m^2). The sum of the three areas was 82,946 m^2. Grey polygons show assessment areas from 2008 to 2014.

Within the clam beds, transects of 100 m in length were laid randomly from the vessel. Samples (0.25 m^2 quadrats) were collected by IMAS researchers at 0 m and every 20 m along the transect (i.e. 6 samples per 100 m transect). A total of 19 transects and 114 quadrats were sampled; 76 quadrats fell within the defined areas and included in the assessment.

A total 184 clams were collected and measured to the nearest 1 mm using electronic measuring boards before being returned to the fishing grounds. The weight of clams per quadrat was then calculated using a mean length-weight relationship derived from previous assessments (Tarbath and Gardner, 2012, 2014; Keane and Gardner, 2017). The mean density of clams per quadrat (g/m^2) was estimated and from this, the total biomass as the product of the mean density and the area of the seabed. Estimates were made of the total biomass (all clams in the defined beds)

and the legal-sized biomass (all clams greater than the legal minimum length (LML) of 40 mm in the defined beds) following methods developed by Haddon (2003).

The estimated total biomass was 10.0 t, with lower and upper 95% confidence limits of 4.4 t and 16.6 t respectively. The estimated exploitable (legal-sized) biomass greater than the LML was 8.4 t, with lower and upper 95% confidence limits of 4.2 t and 12.6 t respectively.

Table 1. Total catch and percentage of total allowable commercial catch (TACC) in parenthesis, TACC, estimated fishery area, estimated total biomass (m^2) and estimated mean biomass (Kg) per m^2 for Venus Clams in Georges Bay Northern Zone. Fish year runs from 01 September to 31st August, fish year 2022 comprises of partial year data complete to July 2022. Catch prior to 2008 is derived from permit reports held by DPIPWE (2007), catch 2008 onwards taken from DPIPWE database catch records. There was no formal TACC set prior to 2008. Data prior to this survey sourced from Haddon (2003), TAFI (2009), Tarbath and Gardner (2012, 2014), Keane and Gardner (2017).

Fish Year ending	Catch (t; % of TACC)	TACC (t)	Assessment Area (m^2)	Total Biomass (t)	Biomass (Kg per m^2)	Density (no./m^2)
2003	43.2		176,258	366.5	2.1	
2004	26.4					
2005	26.4					
2006	26.4					
2007	26.4					
2008	24.0 (100)	24				
2009	23.9 (99.6)	24	121,111	284.7	2.4	134
2010	28.4 (99.6)	28.5				
2011	27.8 (97.5)	28.5				
2012	27.8 (97.5)	28.5	121,111	537.4	4.4	198.2
2013	42.2 (78.6)	53.7				
2014	39.9 (74.3)	53.7	96,393	466.8	4.8	180
2015	24.3 (52.5)	46.3				
2016	1.1 (35.5)	3				
2017	1.5 (50.0)	3	80,759	76.2	0.9	87.4
2018	2.4 (49.9)	4.9				
2019	2.2 (44.2)	4.9				
2020	0.6 (13.1)	4.9				
2021	0.4 (8.0)	4.9				
2022	0.1 (1.25)	4.4	82,946	10.0	0.1	9.3

Clam densities

The highest density of Clams recorded during the survey was at the western end of Bed 1 (the westernmost bed), where densities averaged 28/m^2 and peaked at 124/m^2 (Fig. 2). Only one clam was recorded in 12 quadrats sampled to the north and south of the defined bed, indicating clam resources don't extend immediately beyond the defined bounds within this area. At the eastern end of Bed 1 Clam densities were 3.2/m^2. Clam density in Bed 2 averaged 2.1/m^2. Six quadrats sampled in historic Clam beds to the south of Bed two contained only 3 clams, with Quadrats dominated by seagrass. Clam densities were in Bed 3 17.7/m^2. Clams here were concentrated in a narrow strip on the edge of the channel, with loose sand on the bounding the deeper northern edge and increasingly denser *O. angasi* beds shoreward. No Clams were recorded in the easternmost historic Clam bed.

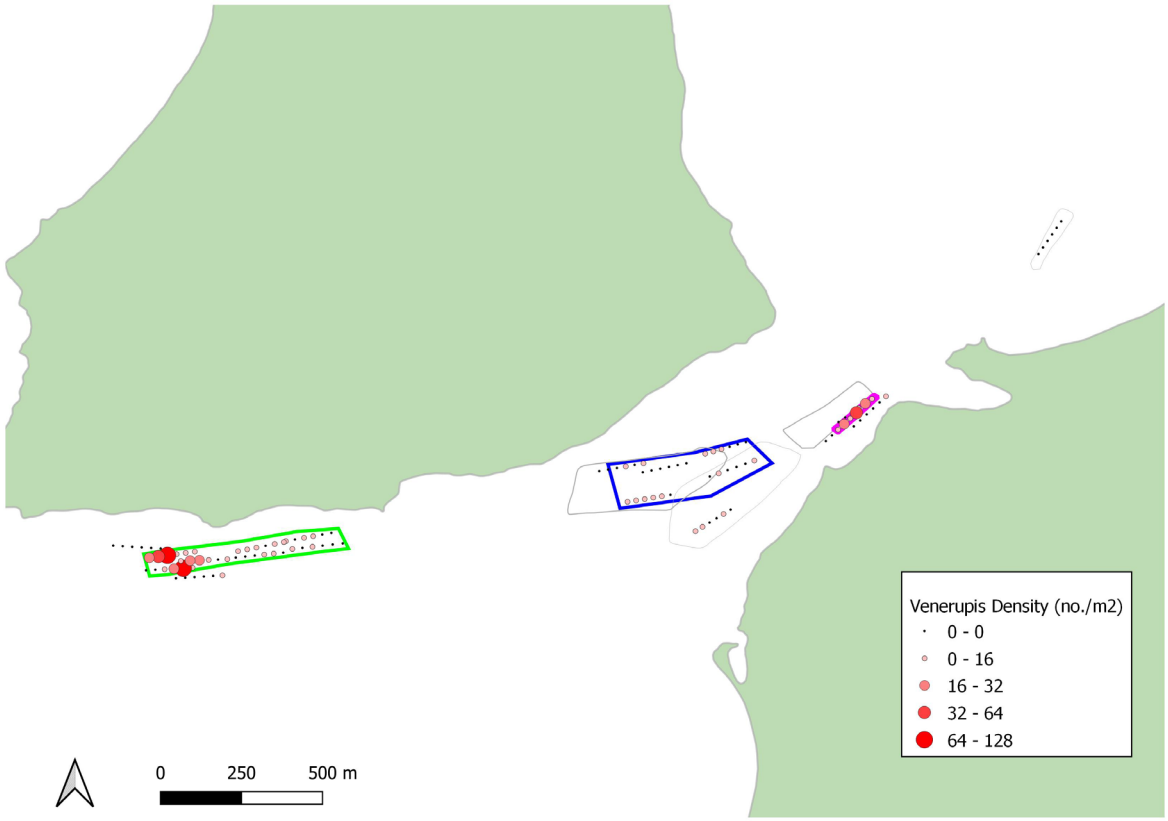

Figure 2. Section of Georges Bay showing Venus Clam densities recored in 2022 and the three areas included in the 2022 assessment. Bed 1, Green; Bed 2, Blue; and Bed 3, Purple. Grey polygons show historic beds (assessment areas) from 2008 to 2014.

Length frequency

Length frequency data in 2022 showed a wide size distribution with no clear cohort structure, unlike previous years (Fig. 3, Fig. 4). Clams were notably larger in Bed 3, where mean length was 48.5 mm. Clams in Bed 1 averaged 39.3 mm, while the low number of clams in Bed 2 were smaller, averaging 28.6 mm. Relatively low abundances of Clams < 30 mm were present throughout the survey area.

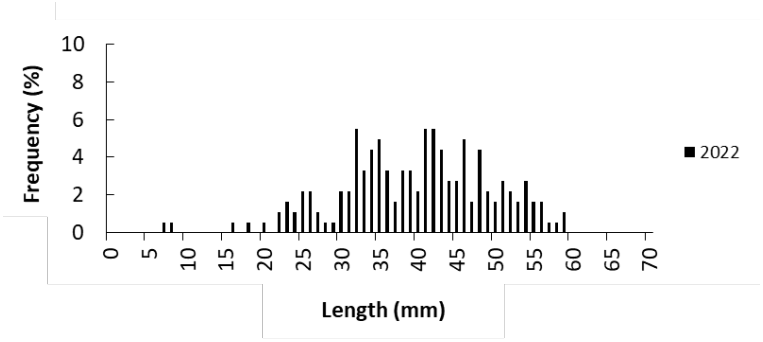

Figure 3. Length frequency (%) distribution of Venus Clams colected in the 2022 stock assessment.

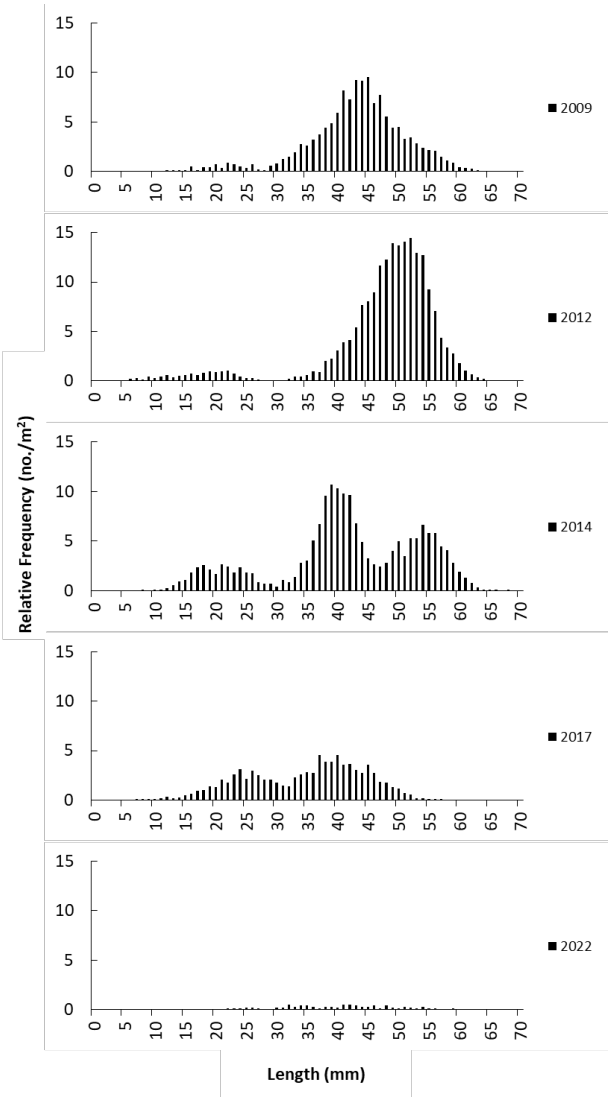

Figure 4. Density adjusted length frequency (no./m^2) distribution of Venus Clams within Georges Bay Northern Zone assessment area between 2009 and 2022.

Catch and Effort

Catch since the commencement of the 2019/20 season has totalled less than 1 t pa (Tab. 1.); daily mean catch was 19.0 kg at an average catch rate of 18.0 kg/hr (Fig. 3). Only 55 kg has been recorded in the first 10 months of the 2021/22 season, and no catch has been reported since November 2021. At the peak of the fishery in 2012/13 daily catches averaged 226.9 kg and catch rates averaged 80.9 kg/hr. CPUE in the 2021/22 season is 13.8kg/hr, 17% of it's peak.

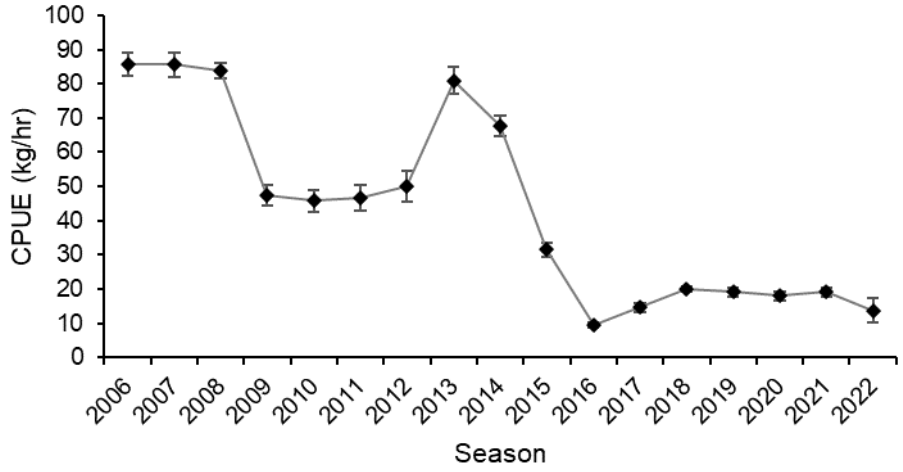

Figure 5. Catch per unit effort (kg/hr) of Venus Clams from Georges Bay 2006 and 2022.

Discussion and recommendations.

This report documents the biomass estimation and management options for Venus Clam stocks in Georges Bay Northern Zone. The TACC for Venus Clam, as defined by the Shellfish Fishery Policy Document (DPIPWE 2007), is 10% of the biomass. For the 2022/23 season, 10% of the exploitable biomass is 0.84 t. A proposed Harvest Strategy prepared by IMAS defined a biomass limit reference point (B_{LIM}) of 107.5 t (20% of B_0 – B_0 was defined as the maximum recorded biomass) (Jones and Gardner, 2016). Under the Harvest Strategy, the current biomass of 10 t (2% of B_0) is less than B_{LIM}, warranting fishery closure. The 2017 policy document update for the Tasmanian minor Shellfish Fishery indicated the adoption of harvest strategies for the management of the Shellfish Fishery (DPIPWE, 2017). The low abundance of sub legal clams throughout the survey area indicates stock recovery in the short term is unlikely. The Georges Bay Northern Zone Venus Clam Stock is Classified as Depleted

Significant environmental changes have been occurring in Georges Bay over the past two decades. Sand spits within the estuary have become overgrown with seagrass (Appendix 1), believed to be the result of increased nutrients in the bay from of regular freshwater flows and sewage spills (DPIPWE, 2017). The sand spit sediments have become more anoxic and less suitable as clam habitat (DPIPWE, 2017). This environmental / ecosystem change contributed to the Clam fishery in the Southern Zone ceasing and the lapsing of the licence. Venus Clams in the Northern Zone also showed a marked decline in abundance from 2015, with cohorts identified in earlier years failing to progress into the fishery (Jones and Gardner, 2016). Environmental processes resulting in Clam biomass declines in the Southern Zone are also believed to be impacting the Northern Zone, with increased seagrass abundance observed intertidally and subtidally. In addition, deeper mixed shellfish beds, which contain both Venus Clams and Native Oyster (*O. angasi*), have seen a doubling of oyster biomass between 2016 (4.7kg/m^2; Jones and Gardner, 2016) and 2021 (10.0 m^2; Keane, 2021). The Native Oysters also appear to be out competing the Venus Clams in area's they overlap. The Georges Bay Native Oyster reef system, the last of at least 118 historically known to exist, has enhanced ecological values for the estuary, and is considered a threatened ecological community (Gilles et al., 2018).

The Georges Bay Venus Clam stock has previously been categorised as Environmentally Limited. This is where environmental processes, especially freshwater pulses, have altered recruitment and natural mortality to atypical levels so productivity has declined (Maguire, 2005; Jones and Gardner, 2016). The significant increase in seagrass throughout the mid estuary, increased Native Oyster abundance, as well as environmental flows, are all likely negatively impacting Clam stocks. Data from this survey indicates the abundance of clams in the Georges Bay Northern Zone has decreased by 95%, and biomass by 98%, since 2012.

Given the significant ecosystem changes in the Georges Bay estuary described above, and the direct impact on Venus Clam habitat, it is not foreseeable for the biomass of Venus Clam to be rebuilt to historic levels. Subsequently, the reference points defined in the Venus Clam Harvest Strategy (such as B_0 and B_{LIM}) appear no longer appropriate and should be reviewed.

Due to limited fishing activity this survey was conducted over historic shellfish beds as opposed to current fishing grounds. Much of the 2022 survey area recorded a low abundance of clams and is unlikely to be fished. Increased precision in TACC estimates, particularly the area occupied by the fishery, would provide increased certainty in the estimate of biomass and subsequent calculation of TACC. This could be achieved by the mandatory use of GPS and depth/time

loggers (spatial data), as adopted by the Abalone and Commercial Dive Fisheries. For future biomass estimate surveys the use of spatial data within the fishery would provide an accurate picture of the total fishable area, which could replace in part, the use of fishery images used prior to surveys to establish the boundaries of the bed. Using the GPS records as a measure of effort and fishery area as scale, the intensity of samples taken in each bed could be determined giving spatial resolution to the fishery. The coupling of CPUE and catch data to GPS records by fishing event, through docket records also provides the opportunity to explore spatiotemporal patterns in harvest and population dynamics, and could facilitate the establishment of meaningful and accurate fishery performance indicators. Furthermore, the adoption of GPS logging by the Venus Clam, Native Urchin and Shortspined Sea Urchin Fisheries will allow the level of spatial overlap to be determined between these fisheries in Georges Bay.

The Venus Clam is endemic to New Zealand but was found in Tasmania in 1963. Given the introduced nature of this species, coupled with the significant decline in stock abundance and value, the management objectives and assessment methods for this species may warrant review. A reduction in fishing mortality from 10% to 5 % should be considered through a stock rebuilding phase, should environmental conditions permit stock rebuilding. Fishery monitoring methods such as GPS logging and size structure sampling by fishers may be a cost-effective means to enable data flow into the future.

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Apendix 1. Historical satelite imagary of Georges Bay showing increasing seagrass density within the estuary.

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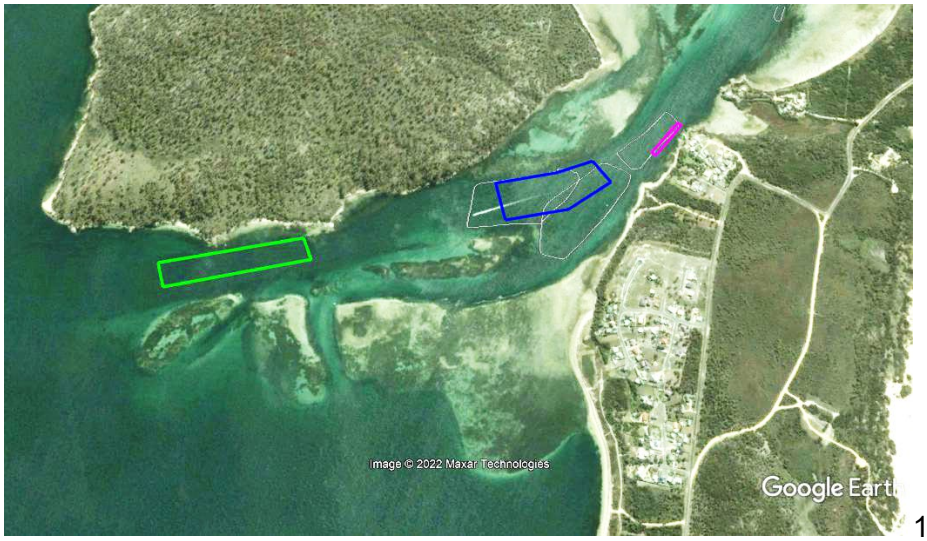

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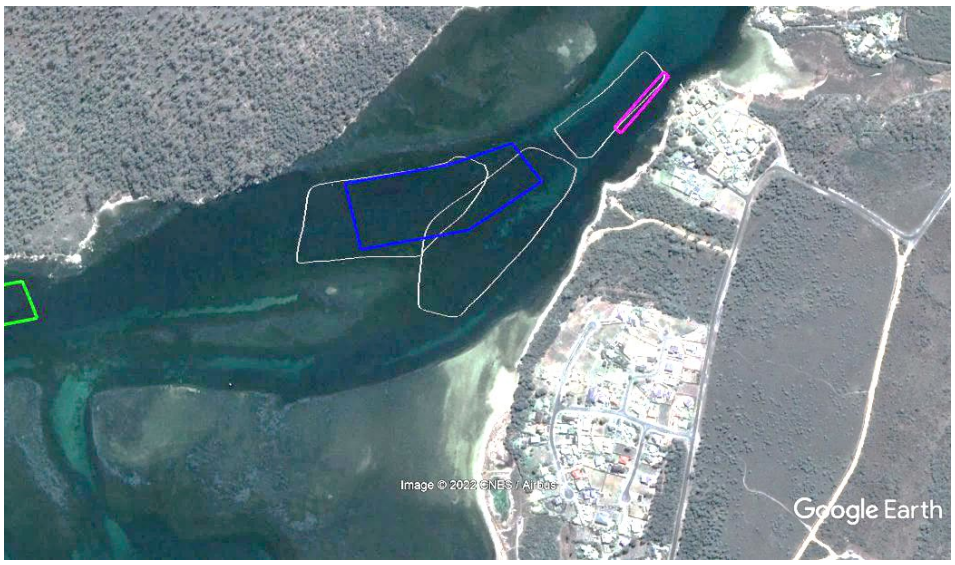

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